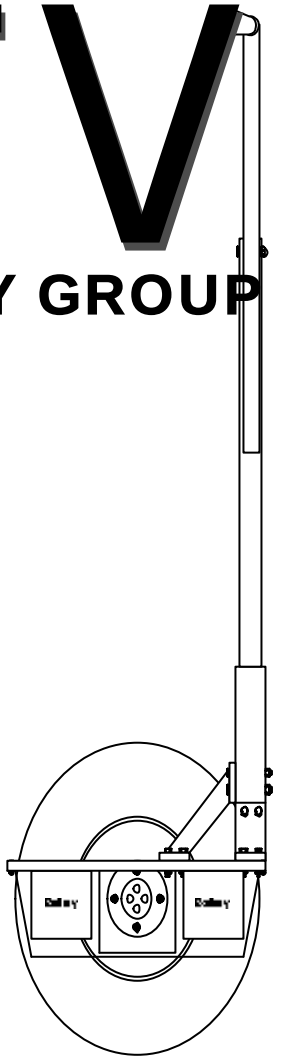
HTV

TECHNOLOGY GROUP



User Manual

HTV Technology Group
USER MANUAL

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Background

This instruction manual illustrates the basic assembly, maintenance, and operation of the HTV self balancing vehicle. The Human Transport Vehicle or HTV was designed and constructed by Technologist students at Camosun College. The HTV is based on a similar commercial vehicle, but it is meant for demonstration purposes only. The intent of the construction of this vehicle was to explore the fundamentals of balancing a mechanical system with an electronic control system. Users of this vehicle should be accompanied by someone qualified to handle the technical equipment involved.

Organization of this document

The reader should be mindful of the symbols shown below. Figures with bold and underlined numbers above them refer to the step number.

A caution symbol will be followed by a safety explanation.

Tip: The tip symbol will be followed with advice for smoother operation.

Tools and Materials

The HTV consists of the following components:

- Physical structure (1)
- Handlebar and quick-release clamp (2)
- Steering control (3)
- Four 12 volt batteries
- Two battery straps (4)
- Battery connector cable assembly
- Ribbon cables
- Solenoid
- DB9 null cable (5)
- Motor driver board
- Motor control board
- Balance control board
- Power supply board
- Battery charging connector (6)

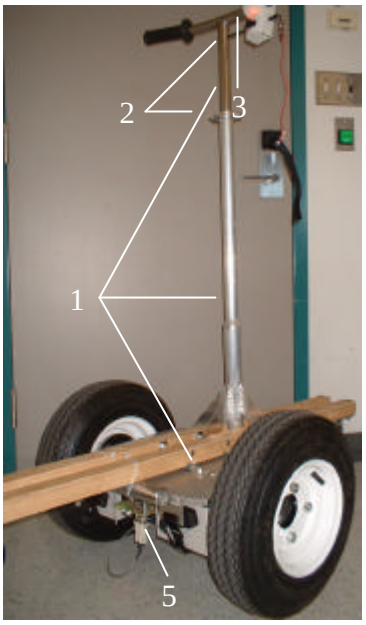
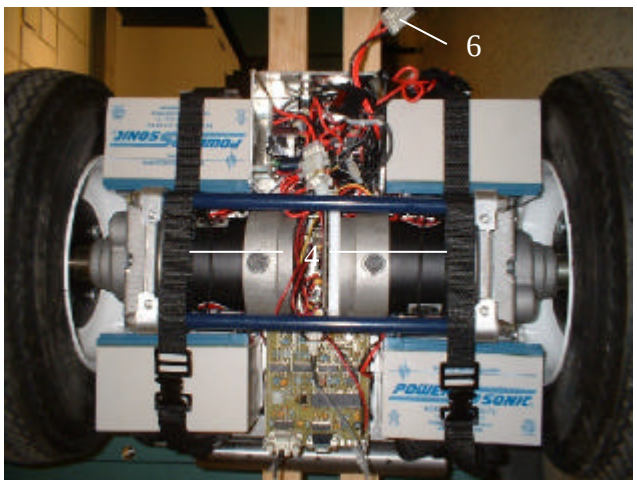


Figure 1: Structure of the HTV

The following tools are required to assemble and operate the HTV:

- Adjustable wrench
- Allen Keys
- Bench top power supply



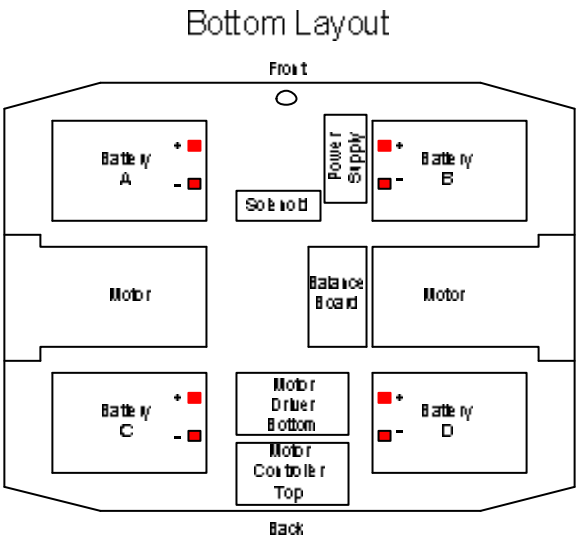


Figure 2: HTV bottom View

Handlebar Adjustment

1. Refer to Figure 3.
2. Pull out the handle of the quick release clamp to open it.
3. Adjust Handlebar to the desired height.
4. Twist the handlebar so that they are facing towards you and parallel to the front edge of the base plate.
5. Make sure the quick release clamp is sitting snug with the top of the HTV handlebar stem.
6. Close the handle of the quick release clamp to lock the handlebar into position.

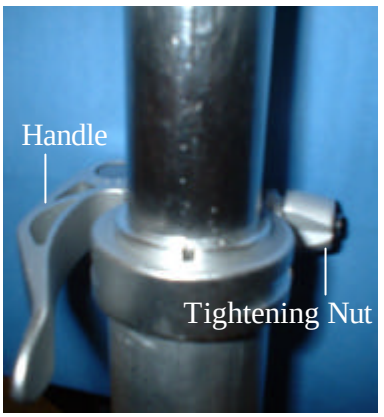


Figure 3: Quick release clamp

Tip: The handlebar will be easier to adjust if the base of the HTV is braced so that it cannot move.

Tip: Make sure the quick release clamp is tight so the handlebar doesn't move. To fully tighten the clamp, pull the handle open, screw in the nut, and then push the handle closed.

Wheels

1. Refer to Figure 4.
2. Always check the condition of the wheels before riding the HTV.
3. Check that the air pressure is 35psi.
4. Make sure the four lug nuts are tight.

Figure 4: HTV wheel

Replace wheels if they are damaged to avoid injury.

Batteries

Use extreme caution when installing and connecting batteries. The open terminals of the batteries are hazardous.

Battery Installation and connections

1. Tilt the HTV forward until the handlebar is resting on the ground.

Make sure that the HTV is secure in its horizontal position before continuing. The weight of the batteries will force the HTV into a vertical position if it is not secure.

2. Refer to Figure 5.
3. Install each battery in its designated area with Velcro side facing the base plate and the terminals facing the motors.
4. Refer to Figure 6.
5. Connect a wire between - terminal of battery A and + terminal of battery C.
6. Connect a wire between - terminal of battery B and + terminal of battery D.
7. Connect a wire between - terminal of battery C and – terminal of battery D.
8. Connect a wire from the + terminal of battery A to the anode of one power diode.
9. Connect a wire from the + terminal of battery B to the anode of the other power diode.
10. Fasten the battery straps as shown in Figure 5.
11. Ensure that the batteries are securely in place and are clear of the tires.

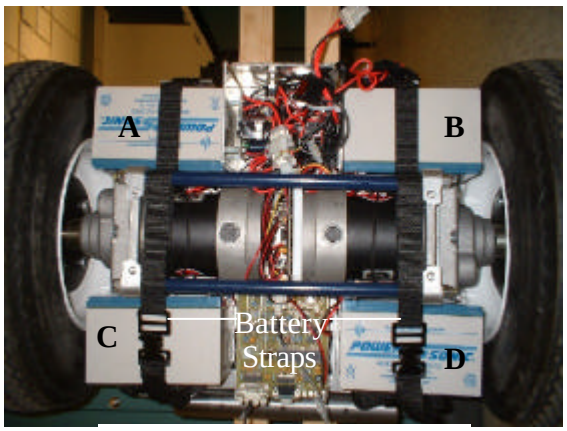


Figure 5: Battery Placement

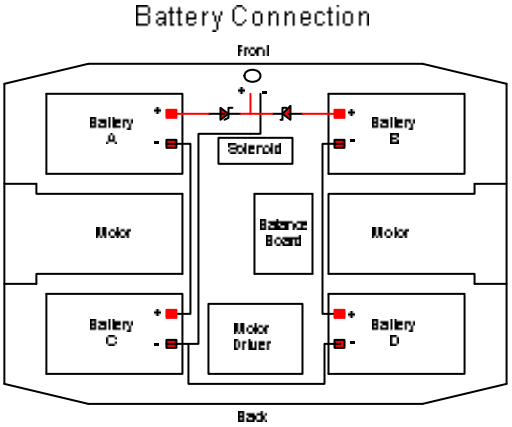


Figure 6: Battery Connections

Connectors

Make sure all the connectors are connected. Each connector has been given a number and its appropriate socket has the same number. See Figure 7 for an example of the numbering.

Never turn on vehicle if one of the connectors (Except for the charging cable) is loose or disconnected.

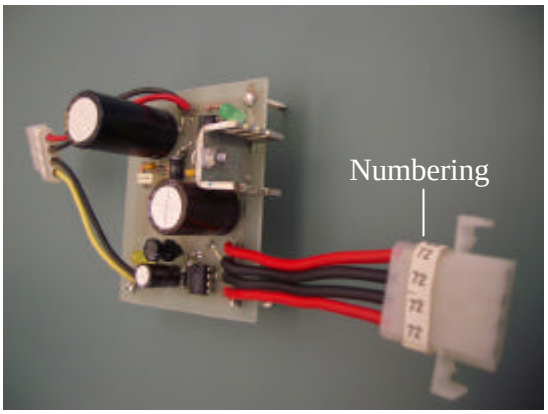


Figure 7: Numbered connector

The structure of this vehicle is designed to transport one person only.

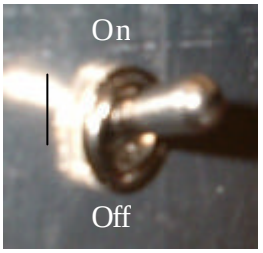


Figure 8: Power Switch

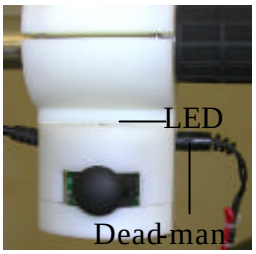


Figure 9: Dead-man

Turning on the HTV

1. Bring the HTV to an upright position.
2. Locate the power switch.
3. Toggle the power switch to the ON position as shown in Figure 8.
4. Insert the dead-man switch into socket shown in Figure 9 (Red LED will illuminate).

Tip: When the power switch has been turned to the ON position there should be four visible LEDs on the back of the HTV which indicate the logic boards are on.

Stepping on the HTV

1. Refer to Figure 10.
2. Bring the HTV to an upright position.
3. Place one foot on the riders platform.
4. Ensure that the HTV is stable.
5. Place the other foot on the riders platform while keeping platform horizontal.

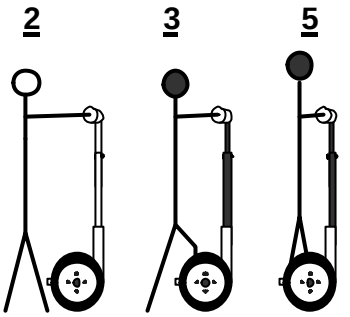


Figure 10: Stepping on the HTV

Do not try to step on the HTV if the power is off, it will not keep you balanced.

Tip: The HTV's movement is what keeps you balanced, try not to fight it. Try to make smooth movements when riding the HTV.

Movement

1. Refer to Figure 11.
2. Lean forward to move forward.
3. Lean back to slow to a stop.
4. Center your balance to remain stopped.

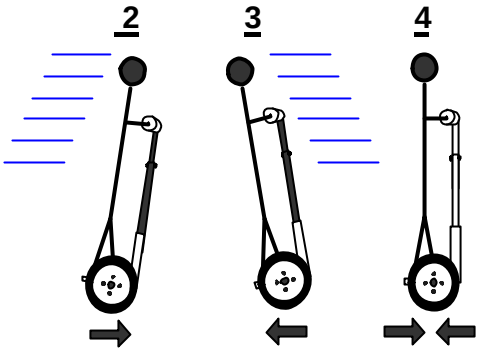


Figure 11: Controlling the HTV

Tip: The HTV will never be completely stopped, as it still has to move to keep you balanced.

Steering the HTV

1. Refer to Figure 12.
2. Locate the steering control.
3. Slide the joystick to the left to turn the HTV left.
4. Slide the joystick to the right to turn the HTV right.
5. Leave the joystick in its centered rest position to make the HTV go straight.

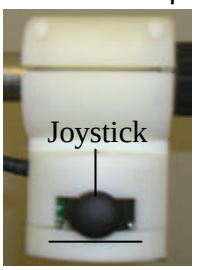


Figure 12: Steering control

Never try a maximum turn at high speeds or take your hands off the handlebars when steering the HTV.

Tip: The HTV steering control is proportional; the more you slide the control in a certain direction the faster the HTV will turn.

Turning off the HTV

1. Bring the HTV to a stop.
2. Step off the HTV while making sure the HTV remains in an upright position.
3. Refer to Figure 13.
4. Unplug the dead-man switch while holding the handlebars.
5. Locate the power switch.
6. Toggle the power switch to the OFF position as shown in Figure 14.

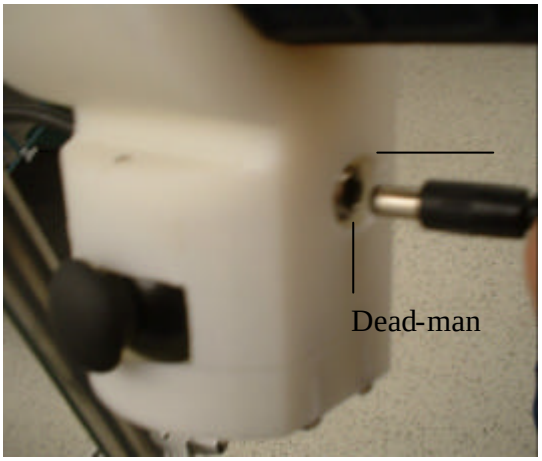


Figure 13: Dead-man

Figure 14: Power Switch

Recharging the Batteries

1. Refer to Figure 15.
2. Locate the power switch.
3. Toggle the power switch to the off position.
4. Unplug the dead-man switch.
5. Locate the charge cable (labeled number 46) under the riders platform.
6. Refer to Figure 15 for the charge cable.
7. Attach the charge adapter to the charge cable as shown in Figure 15.
8. Turn on the power supply as shown in figure 15.
9. Set both sides of the power supply to 28.8 volts as shown in Figure 15.
10. Turn off the current on both sides of the power supply.
11. Turn off the power supply.
12. Connect both of the power supplies' negative terminals together as shown in Figure 15.
13. Attach the black wire from the charge adapter to the negative terminal of the power supply.
14. Attach each of the red wires from the charge adapter to each voltage supplies' positive terminal.
15. Turn up the current on both of the supplies to 2.4 amps max.
16. Wait until the current on the power supply drops to about 120 milliamps.
17. Turn off power supply and detach the wires.
18. Unplug the charge adapter cable from the HTV.

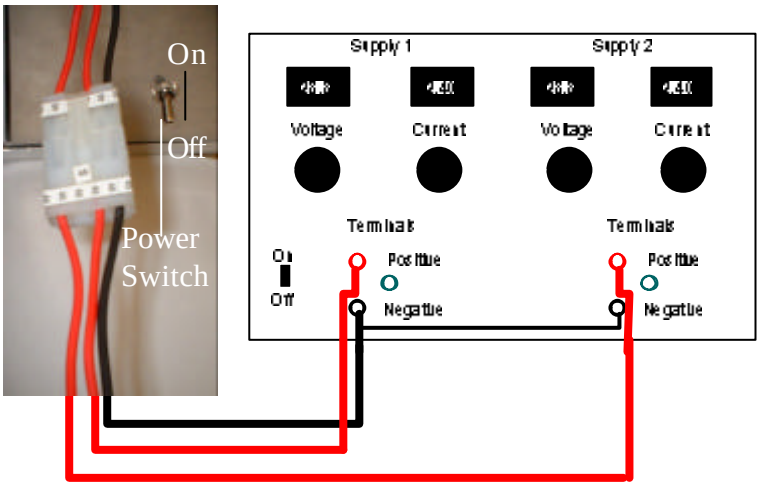


Figure 15: Charging configuration

Safety

The HTV is a dangerous piece of equipment and can cause serious bodily harm. Great care should be taken while operating this vehicle.

HTV Safety Features

The dead-man switch, when worn properly around the wrist, detects if the user has fallen from the HTV and will automatically cut the power to the motors. On board sensors and electronics will detect if the vehicle is operating outside of safe electronic parameters and will automatically switch the HTV off.

Troubleshooting

If the HTV fails to operate check the following:

- The power switch is on.
- The dead-man switch is connected.
- The batteries are fully charged.
- All connectors are attached.
- The red LED in the steering switch enclosure is on.
- The LEDs between the batteries on the back of the structure are on.

If the HTV still won't operate, contact any member of HTV Technology Group and report the problem.

Conclusion

The operations of the HTV were designed to be intuitive for the user. A little practice is all that is needed to become comfortable riding this vehicle.